METHOD FOR LOADING A FIBROUS SUSPENSION AND ARRANGEMENT FOR IMPLEMENTING THE METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application is a U.S. National Stage Application of International Application No. PCT/EP2004/053263 filed December 3, 2004, which published as WO 2005/056918 A1 on June 23, 2005, the disclosure of which is expressly incorporated by reference herein in its entirety. Further, the present application claims priority under 35 U.S.C. § 119 and § 365 of German Application No. 103 57 437.9 filed December 9, 2003.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The invention relates to a method for loading a fibrous suspension containing cellulose fibers with calcium carbonate.

2. Description of Background Information

[0003] When a fibrous suspension is treated according to the fiber-loading technology, calcium carbonate is precipitated. This process is already described, e.g., in DE 101 13 998 A1. The calcium carbonate is mostly precipitated in the form of rhombohedral or scalenohedral crystals.

SUMMARY OF THE INVENTION

[0004] The aim of the invention is to create another method for producing a fibrous material loaded with calcium carbonate.

[0005] According to the invention, a method includes the following steps:

- Introduction of calcium hydroxide in liquid or dry form or of calcium oxide into the fibrous suspension;,

- Introduction of gaseous carbon dioxide into the fibrous suspension; and

- Precipitation of calcium carbonate in spherical agglomerations of crystals by the carbon dioxide.

[0006] Thereby either the calcium oxide or calcium hydroxide is introduced into water in which carbon dioxide is already dissolved or still present as a gas, i.e., in a carbon dioxide atmosphere; or, vice versa, the carbon dioxide is introduced into a suspension and/or solution of calcium hydroxide.

[0007] With the invention, a method is created according to which, based on rhombohedral or cubic crystals, spherical agglomerations of these crystals are formed. The crystals have a diameter of up to 5 μm. Additionally, the crystals have a large volume, and thus, make it possible to produce paper with a high volume or low density, whereby at the same time the paper contains a high proportion of calcium carbonate. The proportion of calcium carbonate can be up to 50%. The agglomerations themselves take up a lot of space in the interior of the cellulose fibers and force these cellulose fibers apart. This forcing apart of the cellulose fibers causes the reduction of the density of the fibrous suspension and the paper web to be produced therefrom.

[0008] The fiber-loading process makes it possible to precipitate filler (calcium carbonate) directly in the stock preparation of a paper mill, which calcium carbonate is distributed and deposited evenly on, in and between the paper fibers. Additionally, the fiber-loading process makes it possible to subject the treated fibrous material to a beating treatment at the same time during the precipitation process. The beating energy is between 0.1 and 300 kW/h per ton of dry paper stock.

[0009] In contrast to customary processes for the production of a fibrous suspension, a cost-effective method can be created according to the invention, which saves refiner energy. Additionally, with the present invention better dewatering, better drying, and a higher filler content, etc. are ensured. The fiber-loading technology is applicable to all

types of paper, e.g., to copier and printing paper of all types, coated paper of all types, newsprint paper of all types, cigarette paper of all types, B&P papers of all types, sack kraft papers and all types of filter papers. The process according to the invention runs preferably at temperatures between 20 and 60°C.

[0010] According to the invention, a method is described to produce fiber-loaded precipitated calcium carbonate (FLPCC), in particular for chemical pulping or for the use of cellulose in paper production. The fibrous raw material to be loaded is produced, e.g., from recycled paper, from de-inked paper (DIP), from secondary fibrous material, bleached or unbleached cellulose, wood pulp of any type, any raw paper pulp, bleached or unbleached sulphate pulp, finished stock broke, linen, cotton and/or hemp fibers (predominantly used for cigarette paper) and/or any other paper raw material used in a paper machine.

[0011] The method according to the invention can be used irrespective of whether the final product contains filler that was produced by a precipitation process in a batch reactor or by a beating process ground calcium carbonate (GCC), or in which talc, silicon, titanium dioxide (TiO_2) are used.

[0012] In the FLPCC process described below with the production of spherical crystal agglomerations, the filler material used with other production methods is replaced by the filler material produced with the fiber-loading process technology. The field of application of the filler produced with the fiber-loading process technology extends to paper production and to the fields of application of all paper types, including cigarette papers, filter papers, sack kraft papers, cardboard and packaging papers having a filler content between 1 and 60% or featuring a white facing with a filler content between 1 and 60%.

[0013] The field of application of the invention is not limited to the use of these fillers in paper-producing processes; the invention can be used in any paper-producing process or auxiliary process including chemical pulping. If a fibrous suspension in paper production is treated with the fiber-loading technology, a completely new product results, which ~~that~~ has new and improved properties in comparison to products known on the

market. The process described below makes it possible to precipitate filler (calcium carbonate) directly in the stock preparation of a paper mill, which filler is evenly distributed and deposited exclusively on and in the fibrous material, in particular the paper fiber.

[0014] Through the use of an additional washing process, the filler not deposited on or in the fibers, i.e., freely precipitated calcium carbonate, is washed out. In embodiments, the additional washing process may be after the crystallization process in a crystallizer and/or before a beating process and/or after the beating process and/or before the headbox vat or before the feed to the paper machine. The fibers themselves that are provided with filler inside and outside do not lose this through the washing process and the guiding back of the press filtrate, so that the positive effects of the fiber-loading technology remain.

[0015] Through the use of guiding back the press filtrate to a receiver vat or another holding arrangement on the input side, a set or adjustable constant content of calcium hydroxide in the feeding system of the fiber-loading device is achieved. The calcium hydroxide can be fed directly in a pulper. The press filtrate can be fed back into the pulping system. Calcium hydroxide that does not deposit on or in the fibers is fed back to the upstream processes.

[0016] In particular, the invention comprises a method according to which the fibrous suspension is introduced into a press arrangement for pressing out a filtrate. Subsequently, the filtrate is fed back, at least in part, into an arrangement for slushing the fibrous suspension, i.e., into a holding tank on the input side, e.g., into a receiver vat. The calcium hydroxide is added, at least in part, in the arrangement for slushing the fibrous material. In the complete pulping system, i.e., in the arrangement for slushing the fibrous material, a pH value between 6 and 11.5, in particular between 8.5 and 10.5, is maintained.

[0017] Calcium hydroxide in aqueous or in dry form or calcium oxide is mixed into the aqueous fibrous paper stock in a range between 0.01 and 60% of the solid material proportion present. A mixing device, in particular a static mixer, a receiver vat or a

pulping system, is used for the mixing process. The reactivity of the calcium hydroxide is between 0.01 and 10 minutes, preferably between 1 second and 3 minutes. According to predetermined reaction parameters, dilution water is mixed in.

[0018] In an advantageous embodiment, the invention relates to a method in which a mixing device, in particular a static mixer, a refiner, a disperger and/or a fluffer FLPCC reactor is used as a reactor. With a mixing device, in particular a static mixer, the fibrous material content, in particular the paper content, is between 0.01 and 15%. With a refiner and with a disperger, the fibrous material content, in particular the paper content, is between 2 and 40%. With an LC beating, the fibrous material content, in particular the paper content, is between 2 and 8%. With an HC beating, the fibrous material content, in particular the paper content, is between 20 and 35%. With a fluffer FLPCC reactor, the fibrous material content, in particular the paper content, is between 15 and 60%.

[0019] In an advantageous embodiment of the method it is provided to use an energy input between 0.3 and 8 kWh/t, in particular between 0.5 and 4 kWh/t, for the precipitation reaction.

[0020] Static and/or mobile, in particular rotating, mixing elements are used for the production of a fibrous suspension loaded with calcium carbonate.

[0021] The reaction time is hereby between 0.01 and 60 seconds, in particular between 0.05 and 10 seconds.

[0022] The invention also relates to an arrangement for implementing one of the methods described above. In this arrangement, the reactor is a crystallizer, a refiner (beating machine), a disperger and/or a fluffer FLPCC reactor.

[0023] It is advantageous if an additional mixing device, in particular a static mixer, is present before a dewatering screw, in which mixer the fibrous suspension is mixed with calcium hydroxide.

[0024] In a further embodiment of the invention, it is provided that filtrate of the fibrous suspension obtained in the dewatering screw can, in part, be fed back via a line to

a receiver vat or another upstream device for preparing the fibrous suspension and/or is added as dilution water, in part, after the mixing device, in particular the static mixer, the refiner, the disperger and/or the fluffer FLPCC reactor.

[0025] ~~It~~ An additional washing device for cleaning the fibrous suspension can also be advantageously provided, arranged after the crystallizer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] The invention is explained below in more detail on the basis of exemplary embodiments. They show:

Fig. 1 A first diagram of the preparation of a fibrous suspension to be used in a machine for the production of a fibrous web; and

Fig. 2 A drawing of agglomerations of calcium carbonate crystals distributed within fibers of the fibrous material.

DETAILED DESCRIPTION OF THE INVENTION

[0027] A tubing system 1 (Fig. 1) is provided for a fibrous suspension, which system is equipped with control valves 2, 3. Control valve 2 is arranged in a line 4 via which the tubing system 1 is connected to a mixing device 5, in particular a static mixer. In the mixing device 5, dilution water is added via a valve 6. A vat 7 or a container for storing the fibrous suspension is arranged downstream of the mixing device 5 in the flow direction of the fibrous suspension. The fibrous suspension is pumped from the vat 7 via a pump 8 to another mixing device 9. Dilution water is also added to the mixing device 9 via a valve 10. The inflow of a suspension of calcium hydroxide is controlled via a valve 11 ~~as well~~, which is mounted in a line 12.

[0028] This calcium hydroxide is made available by a preparation device 13 in which solid calcium oxide or calcium hydroxide is introduced into water. To this end, water is fed to the preparation device 13 via a line 14 with a valve 15. The suspension produced in the preparation device 13 is fed into the line 12 via a pump 16.

[0029] A fibrous suspension to which calcium hydroxide has been added thus flows out of the mixing device 9 into a line 17 with a valve 18 to a dewatering screw 19. In the dewatering screw 19 water is extracted from the fibrous suspension and is fed back as dilution water, e.g., via a line 20 to the mixing device 5. Alternatively or additionally (as indicated by the dashed lines), the water extracted in the dewatering screw 19 can also be fed to a storage container 21 for the fibrous suspension, or it is fed back to the mixing device 9. In all cases, the pH value can be increased and adjusted in the units upstream of the dewatering screw 19 through the return flow of water containing calcium hydroxide.

[0030] From the dewatering screw 19, the fibrous suspension arrives at a leveling screw 23 via a line 22, in order to homogenize the fibrous suspension. A tank 25 (crystallizer) is arranged downstream of this leveling screw 23 in the flow direction via a line 24. This tank 25 is connected to a carbon dioxide storage container 30 via a line 29 for feeding carbon dioxide, equipped with valves 26, 27 and a pump 28. Carbon dioxide is fed into the tank 25 (crystallizer) from this storage container 30 in order to produce the desired precipitation reaction of calcium hydroxide and carbon dioxide for the formation of calcium carbonate as a filler in the fibers of the fibrous material.

[0031] The carbon dioxide storage container 30 is additionally connected to the leveling screw 23 via another line 31, branching off from the line 29, equipped with a valve 32. Carbon dioxide can thus be fed into this leveling screw 23 as well, in order to carry out, at least in part, the precipitation reaction already in the leveling screw 23.

[0032] Line 29 is also connected via another valve 33 to a mixing device 34, in particular a static mixer. This serves to add further carbon dioxide to the fibrous suspension flowing out of the crystallizer 25 via a line 36 provided with a valve 35.

[0033] From the mixing device 34, the fibrous suspension flows into a mixing container 37. A storage container or machine 38 can be arranged between the mixing device 34 and the mixing container 37, which storage container or machine 38 additionally serves as a filtration device. From the storage container or machine 38, filtrate enriched with calcium carbonate is fed back into the receiver vat 7 or into another upstream unit for preparing the dilution water or the fibrous suspension. The mixing container 37 is

equipped with a rotor 39 for blending the fibrous suspension. From the mixing container 37, the fibrous suspension either flows directly to a headbox of a paper machine (not shown) or is subjected to a further mechanical treatment, e.g., in a refiner feed chest (not shown).

[0034] Fibrous suspension not yet acted on with calcium hydroxide or with calcium oxide can also be fed to the mixing container 37 by the tubing system 1 via the valve 3 and a line 40 in which the valve 3 is mounted.

[0035] It is further provided that white water, or process water, and the fibrous suspension recovered, e.g., from the dewatering screw 19, is fed to the container 21 via a tubing system (shown with a dashed line). It is additionally provided that white water, or process water, recovered, e.g., in the screen area of a paper machine (not shown), is fed to the container 21 from the machine for the production of the fibrous web, in particular the paper machine. Dilution water is fed from the paper machine (not shown) to the container 21, e.g., via a line 41 with a valve 42.

[0036] Dilution water mixed with process water flows from the container 21 via a line 43, a pump 44 as well as a valve 45 to the crystallizer 25. Thus, according to the setup of an arrangement for loading the fibrous suspension with filler, in particular with calcium carbonate shown in Fig. 1, there are a plurality of possible ways of influencing the composition of the fibrous suspension to be produced in various stages of production.

[0037] Spherical agglomerations 49 of calcium carbonate crystals form within fibers 46, 47, 48 (Fig. 2) of the fibrous material during the crystallization process, in particular when this occurs at temperatures in the range of between 20 and 60°C. Moreover, these agglomerations enlarge the volume of the fibers 46, 47, 48 and bring about the production of overall a fibrous web with a large volume.

List of reference numbers

1 Tubing system
2 Control valve
3 Control valve
4 Line
5 Mixing device (static mixer)
6 Valve
7 Vat
8 Pump
9 Mixing device (static mixer)
10 Valve
11 Valve
12 Line
13 Preparation device
14 Line
15 Valve
16 Pump
17 Line
18 Valve
19 Dewatering screw
20 Line
21 Storage container
22 Line
23 Leveling screw
24 Line
25 Tank
26 Valve
27 Valve
28 Pump
29 Line

30 Carbon dioxide storage container

31 Line

32 Valve

33 Valve

34 Mixing device (static mixer)

35 Valve

36 Line

37 Mixing container

38 Storage container

39 Rotor

40 Line

41 Line

42 Valve

43 Line

44 Pump

45 Valve

46 Fiber

47 Fiber

48 Fiber

49 Agglomerations